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(54) Single layshaft change speed gearbox

(57) A single layshaft constant mesh gearbox for a highway vehicle having the conventional synchronised dog-type ratio changing facilities is provided with, in place of the conventional mainshaft-mounted single plate input clutch located between the gearbox and the engine, a layshaft-mounted multiple interleaved plate type clutch (68) located at one end of the layshaft and provided with forced lubrication for the plates, whereby clutch life for service vehicle applications is greatly increased and access for servicing likewise greatly simplified.

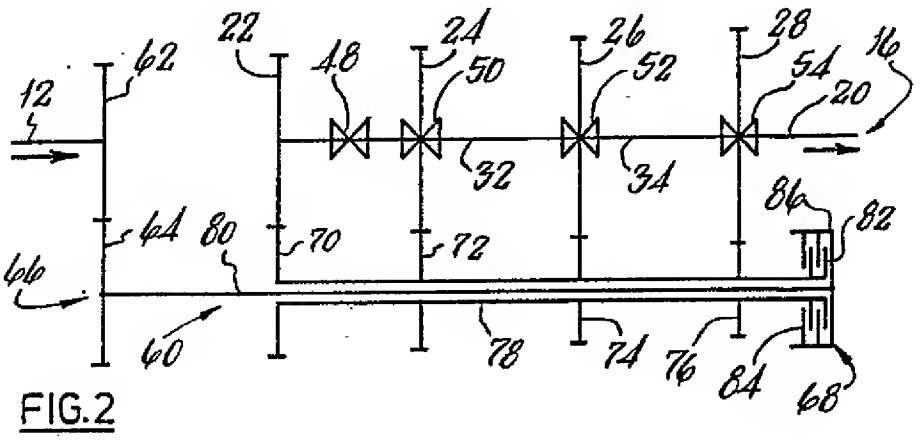

FIG.2

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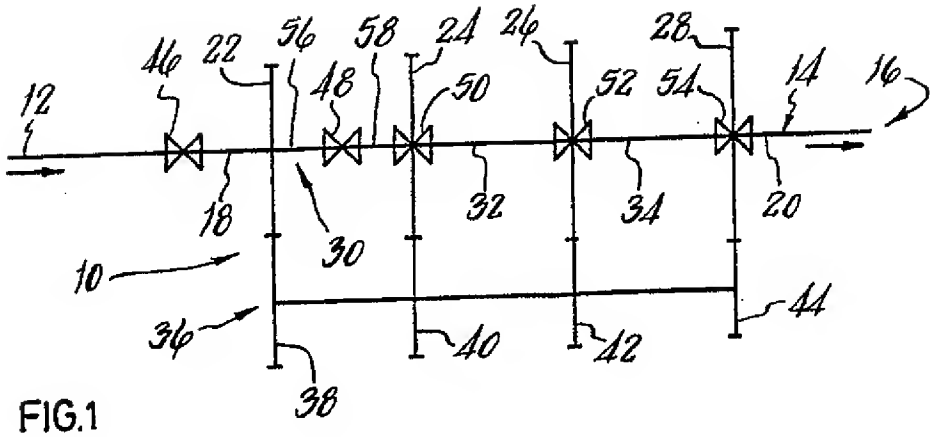

FIG.1

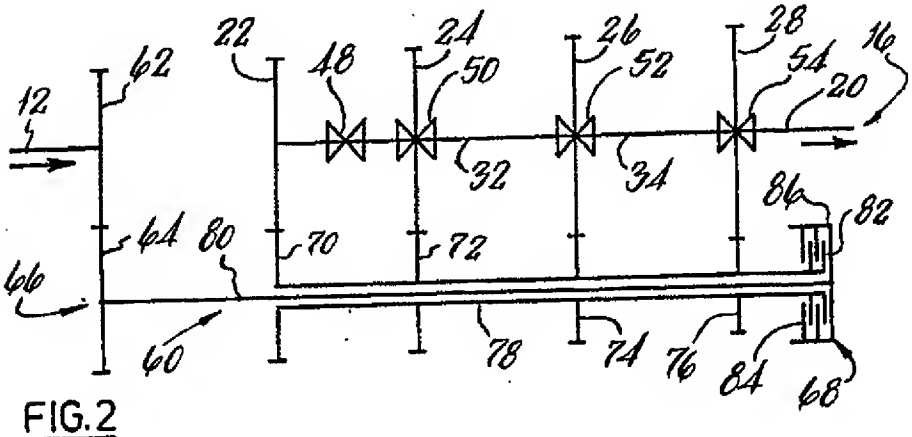

FIG.2

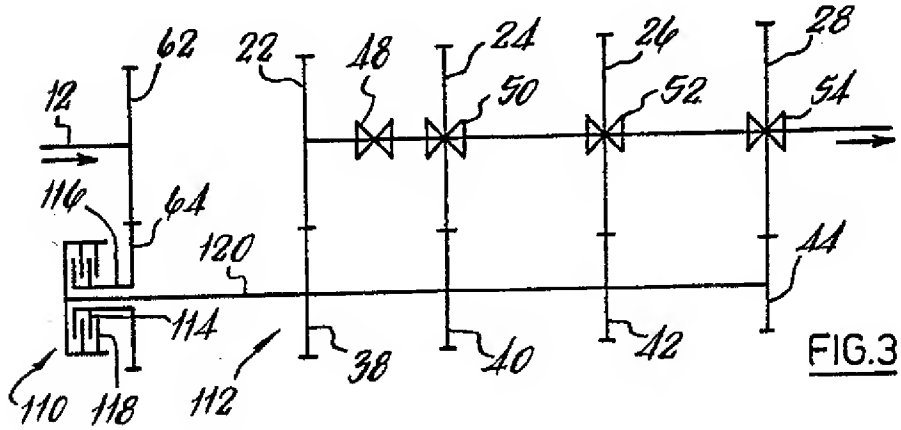

FIG.3

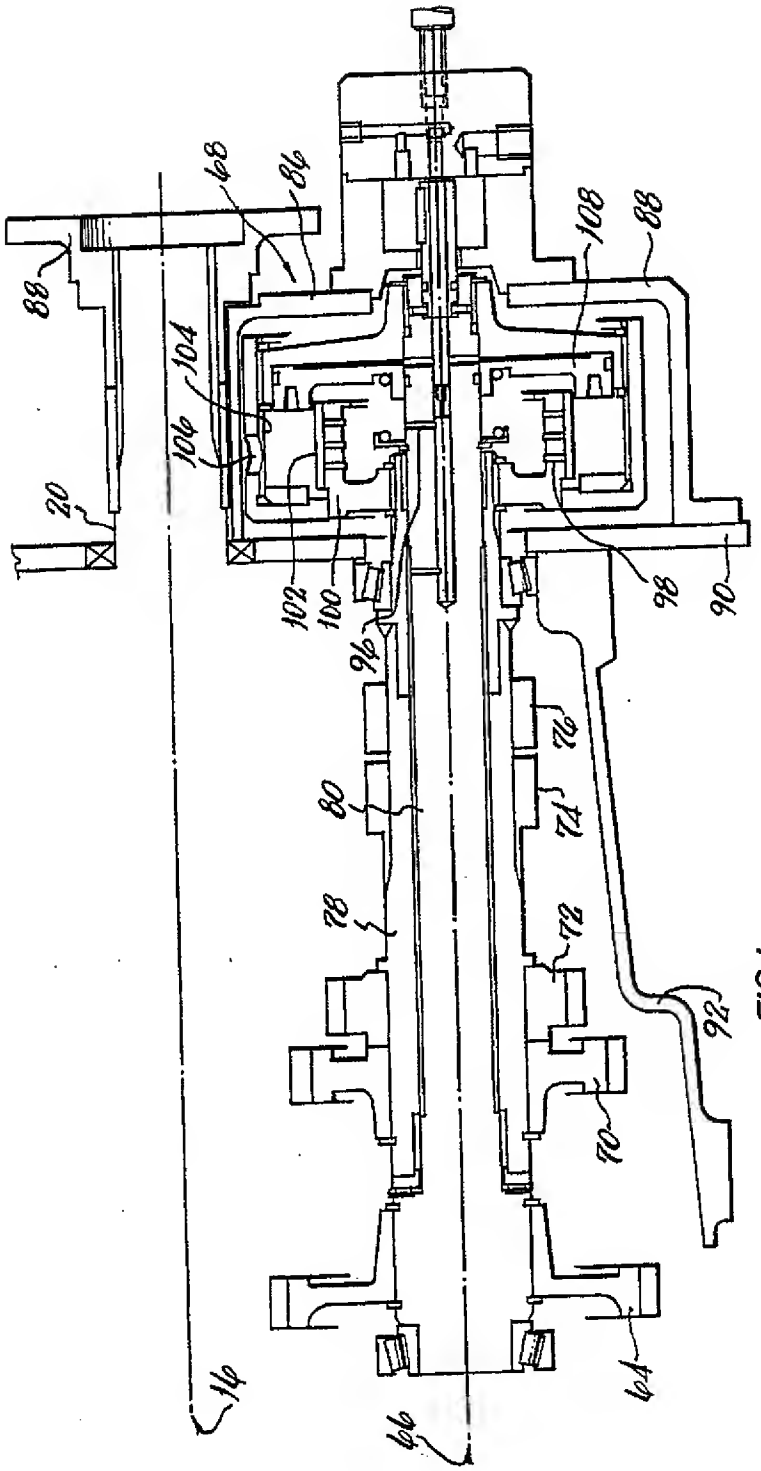
68
66
88
108
88
104
106
20
102
100
98
90
96
76
80
74
78
72
92
70
64
16
66

FIG.4

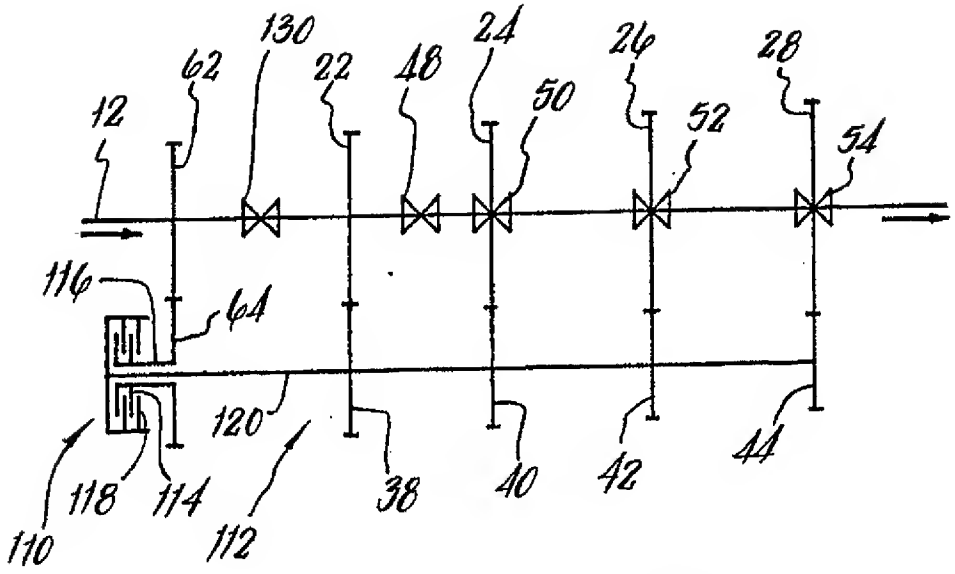
12
62
130
22
48
24
50
26
52
28
54
116
64
120
110
118
114
112
38
40
42
44

FIG.5

SPECIFICATION

Change speed gear train

This invention relates to change speed gear trains. Particularly, but not exclusively, the invention relates to gear trains for vehicles especially highway vehicles such as trucks and automobiles. A preferred embodiment of the invention relates to a gear train of the kind comprising a single layshaft having manually engageable gears with "Synchromesh" (trade mark) pre-engagement means for synchronisaton of rates of rotation. Such gear trains are commonly used in automobiles and light trucks having non-automatic transmissions.

In the case of the conventional single layshaft gear train referred to in the last preceding paragraph, it is conventional also to provide an input clutch which is manually operable to interrupt the drive input to the gear train for the purpose of manual gear shifting during travel and for drive take-up when moving off from rest. Usually the input clutch is of the conventional single plate kind and is located in a bell-type clutch housing which is bolted to the petrol or diesel engine of the vehicle and serves to secure the gearbox to the engine with the input clutch located between the two.

One of the problems which arises in such an arrangement is that although in light duty use in such as in automobiles the life of the input clutch is usually acceptable, in the case of certain types of vehicles such as public service vehicles including refuse carts, the life of the input clutch may be as low as 5000 miles. Thus, every 5000 miles or thereabouts it may be necessary to separate the engine from the transmission and replace the clutch plate or plates, which represents a significant addition to operating costs both in terms of replacement parts and labour.

An object of the present invention is to provide an improved change speed gear train and/or such a gear train offering one or more improvements in relation to the shortcomings of the prior art as discussed above.

According to the invention there is provided a change speed gear train comprising:

a main shaft assembly having an input/output shaft assembly;

a layshaft;

constant mesh gear pairs mounted with one gear of each pair on the layshaft and the other on the main shaft assembly;

clutch means for the gear pairs and operable to selectively transmit drive between the main shaft assembly and the layshaft; and

input clutch means operable to interrupt the drive input to the gear train to assist ratio changing and/or to take up drive from rest or after a ratio change;

characterised in that said input clutch means is mounted at one end of the layshaft and coaxially therewith, the input clutch means comprising two interleaved sets of clutch plates, one set connected to a tubular outer portion of the layshaft and the other set connected to an inner portion of the layshaft extending through the tubular portion.

Preferably, means is provided for liquid cooling and/or lubricating of said clutch plates. Coolant/lubricant bores may extend lengthwise of the layshaft for this purpose.

Preferably also, said input clutch means is located at the end of the gear train remote from the drive input thereto. Said layshaft preferably has its gears of said gear pairs mounted on said tubular outer shaft portion. The layshaft inner shaft portion is preferably connected to an input gear which is in constant mesh with an input gear on the main shaft assembly.

Said input clutch means may be located at the drive input end of the gear train. In that case the layshaft may have its gears of said gear pairs mounted on the layshaft inner shaft portion. The layshaft outer shaft portion may be connected to an input gear which is in constant mesh with an input gear on the main shaft assembly.

The input clutch means is preferably located in its own housing outside the housing of the gear train. Access means is preferably provided to enable replacement and/or servicing of said clutch plates.

The sets of clutch plates are preferably drivably connected respectively at their outer and inner peripheries to the layshaft portions, the layshaft inner shaft being connected to the outer periphery of one set and the layshaft outer portion being connected to the inner periphery of the other set.

The invention also provides a change speed gear train comprising a single layshaft assembly and having a multi-plate end clutch to provide a drive input clutch therefor.

The invention also provides a gear train comprising any novel feature or novel combination of features disclosed herein.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Fig 1 shows, diagrammatically, a conventional single layshaft four-ratio manually shiftable gear train of the kind used in automobiles;

Fig 2 shows the gear train of Fig 1 adapted in accordance with the present invention and including an input clutch located at the end remote from the drive input;

Fig 3 shows, diagrammatically, a gear train according to the invention and similar to that of Fig 2 but with the multi-plate drive input clutch located at the input end of the gear train; and

Fig 4 shows an axial section through the layshaft and clutch assembly of a practical embodiment of the gear train of Fig 2.

As shown in Fig 1, a gear train 10 for a light truck or automobile provides four transmission ratios between an input shaft 12 directly connected to the crankshaft of an internal combustion engine (not shown), and an output shaft 14 which is directly connected through a differential drive unit (not shown) to the driven front or rear wheels of the motor vehicle.

Gear train 10 comprises a main shaft assembly 16 having gear train input and output shafts 18 and 20 respectively which extend through the end walls of the gearbox (not shown), four main shaft gears 22, 24, 26 and 28, and three main shaft shaft-portions

30, 32 and 34 extending between the mainshaft gears.

A layshaft 36 has four layshaft gears 38, 40, 42 and 44 in constant mesh with the main shaft gears and all permanently drivably coupled to the layshaft.

For ratio-changing purposes, a plate-type input clutch 46 is located between input shaft 12 and the gear train input shaft 18 and is manually operable to interrupt the transmission of drive to the gear train. In addition, four manually-operable dog-type clutches 48, 50, 52 and 54 are provided on main shaft 16 for ratio changing purposes. Each of these clutches is provided with pre-engagement synchronising means of any suitable conventional kind.

Main shaft clutch 48 selectively couples end portions 56, 58 of main shaft portion 30. Main shaft clutches 50, 52 and 54 selectively couple main shaft gears 24, 26 and 28 respectively to the main shaft assembly 16.

In use, input clutch 46 is engaged and disengaged for ratio changing and drive take-up purposes. Main shaft clutches 48, 50, 52 and 54 are operated manually by means of a stick shift lever in association with input clutch 26. Top gear (for maximum road speed) is provided when main shaft clutch 48 is engaged thereby providing a direct drive top gear with no torque increase. In the three other ratios, drive is taken from layshaft 36 through a selected one of the three gear pairs 24, 40 and 26, 42 and 28, 44 according to which of the main shaft clutches 50, 52 or 54 is engaged.

In the embodiment of the invention illustrated in Fig 2, the gear train 10 of Fig 1 has been modified by deletion of the input clutch 46 and modification of layshaft 36. In Fig 2, parts corresponding to those of Fig 1 are given the same reference numerals.

Drive input to gear train 60 of Fig 2 is via a pair of constant mesh input gears 62, 64 on input shaft 12 and layshaft 66 respectively. At one end of layshaft 66, a drive input clutch 68 controls the input of drive to the layshaft and main shaft assembly 66, 16 and layshaft gears 70, 72, 74 and 76 are in constant mesh with the main shaft gears 22, 24, 26 and 28 respectively.

Layshaft 66 comprises a coaxial assembly of an outer tubular shaft portion 78 and an inner rod-type shaft portion 80. The layshaft gears 70, 72, 74 and 76 are mounted on the tubular shaft portion and the layshaft input gear 64 is mounted on the inner layshaft portion 80.

Drive input clutch 68 comprises two sets of interleaved clutch plates 82, 84 shown diagrammatically in Fig 2. The plates of each set may be of conventional construction comprising sintered metal facings having a pattern of oil or other coolant grooves and having drive dogs for drive input and drive output purposes. The set of clutch plates 82 are formed with drive dogs at their outer peripheries which are keyed to the clutch housing 86, and the clutch plates of set 84 have dogs at their inner peripheries which are keyed to the outer tubular layshaft portion 78. The clutch is engaged and disengaged by hydraulic or pneumatic pressure applied to an actuating piston and cylinder assembly not shown in Fig 2.

Fig 4 shows a practical embodiment of the gear train of Fig 2. Corresponding parts are given the same reference numerals in Fig 4 as in Fig 2.

Main shaft assembly 16 has a drive output flange 88. Input clutch 68 has an external housing 88 bolted to a mounting plate 90 on gearbox housing 92.

Also shown in Fig 4 is a coolant oil supply drilling 94 extending axially along inner layshaft portion 80 and supplying oil under pressure via radial oil drillings 96, 98 to the clutch plates 82, 84 (not shown) which are respectively drivably coupled to shaft portions 80 and 78 through a hub 100 and keyways 102 thereon, and by keyways 104 on the rotatable clutch housing 86. Oil under pressure can escape from housing 86 through vents 106 and is re-circulated to the gearbox via cooling apparatus if necessary.

In use, gear train 60 operates in substantially the same manner as gear train 10. For drive take-up and ratio changing, input clutch 68 is disengaged by appropriate adjustment of the fluid pressure applied to an actuating piston 108. In use, drive proceeds via input gears 62, 64 to the outer set of clutch plates 84 via inner layshaft portion 80 and clutch housing 86. When the clutch is engaged, drive proceeds to the layshaft gears 70, 72, 74 and 76 via the inner set of clutch plates 84 and the tubular outer layshaft portion 78. Oil under pressure is passed between the clutch plates through the oil grooves therein, thereby cooling the plates and ensuring that at all times a film of fluid is maintained whereby wear is substantially reduced.

The desired transmission ratio is selected by means of the main shaft clutches 48, 50, 52 and 54, in the same manner and with the same equipment as in the gear train of Fig. 1.

The principal advantages of this embodiment include the following:

1 Greatly increased service life of the input clutch, this arising from the inherently long wearing characteristics of the clutch plates which can be used in the clutch 68, and the lubrication and cooling of the plates during use. The clutch 68 is the kind which can stand heavy duty usage including not only drive engagement and disengagement but controlled slippage for retardation purposes. Hence, it is expected that a service life of 100,000 miles may be realised, even under arduous operating conditions.

2 Improved accessibility of the clutch plates for servicing purposes. In this regard, it is to be noted that the external housing 88 of clutch 68 can be readily unbolted and after removal of piston 108 the two sets of clutch plates can be merely pulled from their splines and a new set inserted. This is to be contrasted with the most inaccessible location of the conventional input clutch 46 in the position between the engine and the gearbox.

3 The input clutch 68 can be retro-fitted to existing gearboxes since it is merely bolted on as an outside extra. The additional input gears 62, 64 can be accommodated in the previous clutch housing.

4 The problem of improving clutch life in a single layshaft gearbox is solved in a simple and relatively

inexpensive way.

The embodiment of Fig 3 differs from that of Fig 2 in having the input clutch 110 at the drive input end of the gear train 112, with its inner set of clutch plates 114 connected to the tubular outer layshaft portion 116 and its outer set of plates 118 connected to the inner layshaft portion 120.

It is the inner layshaft portion 120 on which the layshaft gears 38, 40, 42 and 44 are mounted so that both the layshaft itself and the main shaft assembly are substantially similar to that of Fig 1.

In this embodiment again, the same reference numerals have been used as in Figs 1 and 2 for those parts which are substantially unchanged.

This embodiment operates in substantially the same way as the embodiment of Fig 2, but there is less space available for accommodation of the input clutch 110 at the drive input end of the gearbox in most normal road vehicle transmission layouts.

Fig 5 shows a modification of the invention in which a further clutch 130 is provided between gears 62 and 22, whereby the number of available transmission ratios is doubled from four to eight. Clutch 130 is preferably arranged to be actuated by the vehicle's regular gear shift mechanism. Therefore, this modification can probably not be readily retro-fitted into an existing vehicle.

Input clutch 110 can still function as such. The four ratios previously available in which the input torque passed via gears 62, 64 and clutch 110, have added to them four further ratios in which the torque passes directly from input gaear 62 to mainshaft gear 22. Some of these ratios, particularly the direct drive ratio, may not differ from those previously available, whereby the number of different ratios provided may be only seven.

CLAIMS

1. A change speed gear train comprising:

a main shaft assembly having drive input and drive output means;

a layshaft;

constant mesh gear pairs mounted with one gear of each pair on the layshaft and the other on the main shaft assembly;

clutch means for the gear pairs and operable to selectively transmit drive between the main shaft assembly and the layshaft; and

input clutch means operable to interrupt the drive input to the gear train to assist ratio changing and/or to take up drive from rest or after a ratio change;

characterised in that said input clutch means is mounted at one end of the layshaft and coaxially therewith, the input clutch means comprising two interleaved sets of clutch plates, one set connected to a tubular outer portion of the layshaft and the other set connected to an inner portion of the layshaft extending through the tubular portion.

2. A gear train according to claim 1 characterised by the provision of means for liquid cooling and/or lubrication of said clutch plates.

3. A gear train according to claim 2 characterised by coolant/lubricant bores extending lengthwise of the layshaft.

4. A gear train according to any one of the preceding claims characterised in that said input clutch means is located at the end of the gear train remote from the drive input thereto.

5. A gear train according to any one of the preceding claims characterised in that said layshaft has its gears of said gear pairs mounted on said tubular outer shaft portion.

6. A gear train according to any one of the preceding claims characterised in that said layshaft inner shaft portion is connected to an input gear which is in constant mesh with an input gear of the main shaft assembly.

7. A gear train according to any one of claims 1 to 3 characterised in that said input clutch means is located at the drive input end of the gear train.

8. A gear train according to claim 7 characterised in that said layshaft has its gears of said gear pairs mounted on the layshaft inner shaft portion.

9. A gear train according to claim 8 characterised in that said layshaft outer shaft portion is connected to an input gear which is in constant mesh with an input gear on the main shaft assembly.

10. A gear train according to any one of the preceding claims characterised in that said input clutch means is located in its own housing outside the housing of the gear train.

11. A gear train according to claim 10 characterised in that access means is provided in said housing of the clutch means to permit replacement and/or servicing of said clutch plates.

12. A gear train according to any one of the preceding claims characterised in that said sets of clutch plates of the input clutch means are drivably connected respectively at their outer and inner peripheries to said layshaft portions, the layshaft inner shaft being connected to the outer periphery of one set, and the layshaft outer portion being connected to the inner periphery of the other set.

13. A change speed gear train substantially as described herein with reference to Figs. 2 and 4, or Fig. 3, or Fig. 5 of the accompaning drawings.

14. A change speed gear train comprising a single layshaft assembly and having a multi-plate end clutch to provide a drive input clutch therefor.

15. A drive transmission for a highway vehicle comprising a change speed gear train according to any one of the preceding claims.

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